PATENT SPECIFICATION

DRAWINGS ATTACHED

1,065,109

1,065,109

Date of Application and filing Complete Specification: March 4, 1965
No. 9357/65.
Application made in Germany (No. W36315 VIIa/8a) on March 4, 1964.
Complete Specification Published: April 12, 1967.

Index at acceptance: —D1 B(2L1, 2L2, 2L3, 2L5D); D1 F24
—D 06 p//D 01 b

COMPLETE SPECIFICATION

Process for Dyeing Continuous Filamentary Material

We, E. I. DU PONT DE NEMOURS AND COMPANY, a corporation organised and existing under the laws of the State of Delaware, located at Wilmington, State of Delaware, United States of America, hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention is concerned with a process for dyeing continuous synthetic filamentary material, and, if desired, for crimping the material.

Some synthetic fiber materials are difficult to dye. Frequently only specific dyestuffs may be used, and difficulties and limitations may also arise from the form in which the material shall or must be dyed.

The present invention provides a process which generally allows a more favourable operation of the dyeing process or permits the use of dyeing techniques which otherwise are not operable at all or not in a practicable manner. It makes possible a largely continuous mode of operation and, if desired, easy combination of the dyeing operation with other treatments, e.g. with crimping.

The present invention provides a process for dyeing a continuous synthetic filamentary material comprising continuously depositing the filamentary material in the form of a layer on a support travelling at a lower speed than that of the filamentary material, so that the length of the filamentary deposited on a given length of the support is at least ten times such given length, and subjecting the filamentary material to dyeing while it is in the form of the resulting layer on the support.

Preferably the length of the filamentary material deposited on the given length of the support is at least 150 times such given length.

The filamentary material is thus fed to the support at a rate which exceeds the travelling speed of the support by an amount hereinafter referred to as overfeed. In this way it is laid down loosely and free of tension in loops or windings to form a layer which permits especially good access for special dyeing techniques, such as printing. Moreover, this placement on a support is very simple, and mechanical damage to the filaments which in untwisted condition are very delicate in this respect is avoided.

The extraordinary careful mode of treating the material according to the invention is evident from the circumstances that, according to the invention, untwisted filament bundles can also be handled. In the hitherto known treating methods a protective twist had to be used in order to be able to treat at all. Of course, within the scope of the invention such protectively twisted filamentary materials may be handled with special care.

The filamentary material is practically deposited at such overfeed rate that a filament layer of the desired thickness or density is obtained. With a filamentary material having a total titer in the order to 3000 denier one will normally not exceed, in practice, an overfeed of 400:1 or 500:1, while with finer titters a somewhat higher value will be selected.

Especially favorable is the deposition of the filamentary material on the travelling support such that the filamentary material is passed in the form of loops or windings to and fro from one side of the support to the other and back. With largely flattening windings in which, with dense packing of the fiber material, winding is laid beside winding in a sort of spiral or helical arrangement excellent results are obtained. Of course, the attained density or thickness of the filament layer on the support depends on the overfeed with which the filamentary material is laid onto the (slowler) travelling support, and also on the width of the latter. It is self-evident that

[Price 4s. 6d.]

with a greater width of the support a higher speed overfeed may be used. The deposition width, i.e. the width of the area on which the filamentary material is deposited onto the support, need not be equal to the width of the support but may also be smaller or, especially in proportion to the resulting shrinkage in width of the deposited filamentary layer, may be wider.

For further explanation of the support width it may be added that one can favourably work in practice with supports 20 to 60 cm wide, without the invention being limited to this range.

Deposition with passage of the filamentary material to and fro transversely of the support is possible in various ways. Deposition in the above, especially preferred way may be accomplished with a device where, in principle, the filamentary material coming from the supply package is wound onto a fork-like member from which the windings are stripped one after the other, and which has been hitherto used for making up woollen hand knitting yarns.

The travelling support may be made of various materials, such as polyester and polyolefins and may be foraminous or porous. According to a special embodiment, it is formed accordingly by spaced parallel threads running over corresponding guides or rolls or supports. The support is preferably made of a material which is inert to the dyes in question, i.e. it should not be receptive thereto.

It may be suitable to secure the filament layer on the support against displacement and lifting from the support during the treatment. A preferred possibility of doing that is in the provision of tight holding threads which travel with the filament layer and press it against its backing, such threads being provided in spaced relationship which permit pressure with the desired force. The holding threads may also be arranged in the form of a continuous belt which, according to its nature, is effective over part of its total length, or in lieu of a thread belt a ribbon-like, foraminous material may be employed.

According to a preferred embodiment of the invention, the material is dyed according to the continuous or padding technique to which end the fiber layer backed by the support is passed through a dye liquor. The filamentary material which absorbs dye liquor in excess is subsequently squeezed between rolls to the desired dye absorption. Thereafter follow the conventional operations of setting the type of the fiber, as in a pressure steamer, washing out excess dye and drying which operations may be carried out either after the filamentary material has been wound up again, or also in an especially favorable way with the supported fiber layer in a continuous operation.

This mode of operation, for example, the simple use of dyestuffs which cannot be easily used, or which can be used only with great difficulties, for package dyeing and which permit, for example, the attainment of better color fastness.

The drawing explains this mode of operation in a schematic illustration of the operational steps of the invention. The untwisted filament bundle 2 coming from a supply bobin 1, such as a bobbin of the type normally supplied by the fiber manufacturer to the processing plants, runs to a converter 3 which deposits the filamentary material as a layer 4 on a support 5 and which in the illustrated case is formed by a number of parallel tensioned threads 6 (in the drawing only one supply bobbin 6′ for feeding a supporting thread is shown, whereas in reality further supply bobbins in a number corresponding to the number of threads of the support are provided).

The support 5 travels over supporting rolls 7, 8 into the dye liquor in tank 9, is deflected in the dye liquor as it runs under a deflection roll 10, and then travels over a second supporting roll 11 to a pair of squeeze rolls 12, 12′. The filament layer 4 formed by the converter 3 is deposited in the vicinity of the first supporting roll 7 on the support 5 and is carried along by said support on the path described above for the support. Between the supporting rolls 7, 8 in the preferred mode of operation a group of holding threads 13 running in the given example around rolls 14, 14′, 15 and 16 in the manner of an endless belt is pressed against the filament layer 4 by means of pressure roll 14. The pressure of the holding threads 13 against the filament layer 4 results from the cooperation of the engagement and disengagement rolls 14, 14′ with the deflecting roll 10 in the dye liquor, the supporting rolls 8 and 10 acting practically as tensioning rolls. It will be readily evident that, on the other hand, instead of an endless belt 13 also a group of holding threads may be formed analogous to the group of supporting threads 5. The filament layer 4 coming out of the liquor and being wet with dye liquor is squeezed out between the pair of squeeze rollers 12, 12′ and then travels to the further treatments, such as a steamer 17 provided to set the dye.

The support 5 as well as the holding medium 13 are formed in this embodiment by threads, but they may also be belts as described before.

In the drawing conventional elements, such as drive means for driven rolls, tensioning means for the endless holding thread group, filament guides, such as for the feed of filaments to the converter, means for collecting dye squeezed out by the squeeze rolls and for returning it to the dye tank (the squeeze rolls may also be arranged above the tank so

that dye solution squeezed out of the material flows directly back into the tank) are not shown because they are familiar to those skilled in the art and may be used by them as necessary or desired in each individual case.

According to another preferred embodiment of the invention, the dyeing is carried out according to a printing technique. To this end the filament layer on the substrate is passed by one or more printing rolls (or pairs of printing rolls) which print one or more colors onto the filament layer. By respective arrangement or use of the rolls a deliberately irregular dye distribution on the filamentary material may thereby be obtained in a relatively simple manner. Thus, for instance, in the final article, such as a carpet, a pepper and salt pattern may be obtained in this way. This printing operation is followed by the conventional further treatments as described above.

A special field of application of the invention are artificial filaments having a latent crimp, especially polyamide filaments for the carpet manufacture. To such filaments a latent crimp is imparted during their manufacture or in a special treating step and they are delivered by the manufacturer of by the treating plant to the final processing plant in the form of packages on which the filamentary material does not have an apparent crimp. The crimp is restored during the further processing in that the filamentary material is heat treated, especially steamed, and in order to obtain good results the filamentary material must be held free of tension as far as possible during said restoration of the crimp. The invention permits an extraordinary favorable treatment of such filamentary material since the tension-free condition is obtained when the material is deposited on the support according to the invention, in this way the complicated, slow, expensive and harmful preparation and treatment of very small individual skeins becomes unnecessary which hitherto could not be avoided with materials of this type. Also in that case the invention permits a very sparing, quantatively intensive treatment which can be carried out continuously. The development of the crimp may be effected after dyeing, e.g. in the embodiment illustrated in the drawing after the material has been passed through the squeeze rollers, the holding threads being optinally previously removed. In that the filamentary material dyed according to the invention is passed through a heat treating zone. Even more favourable is crimping prior to dyeing, above all in view of the increased coherence of the filamentary material in crimped (bulky) condition. The supply of heat may be effected in various ways, e.g. by radiation or, more favourably, the heated fluid media. Preferably saturated steam is used.

Typical examples for the filamentary material to be treated according to the invention are filaments consisting of synthetic, linear, crystallizable polymers, such as polyamides (nylon) and polyesters, these terms as used herein comprising also respective copolycondensates and copolymers, as well as polypropylene filaments. A special field of application of the invention is the treatment of coarse denier polyamide filament material, preferably having a thickness of at least 500 deniers, for the manufacture of carpets.

Filamentary materials of widely varying total titer are accessible to the treatment of the invention. As a rule, materials in the order of 500 to 5000 denier or more will be used; a range of about 1300 to 3700 seems to be particularly favourable.

The filamentary material to be treated according to the invention may have a latent crimp, as described above, but may also be already crimped, textured, or smooth.

WHAT WE CLAIM IS:—

1. A process for dyeing a continuous synthetic filamentary material comprising continuously depositing the filamentary material in the form of a layer on a support travelling at a lower speed than that of the filamentary material, so that the length of the filamentary material deposited on a given length of the support is at least ten times such given length, and subjecting the filamentary material to dyeing while it is in the form of the resulting layer on the support.

2. A process according to claim 1 in which the length of the filamentary material deposited on the given length of the support is at least 150 times such given length.

3. A process according to claim 1 or 2 in which the layer comprises densely packed, flat loops extending from one side of the support to the other.

4. A process according to any of claims 1 to 3 in which the support is a foraminous or porous support.

5. A process according to any of claims 1 to 3 in which the support is constructed of parallel tensioned threads.

6. A process according to any of claims 1 to 5 in which the layer is held in position on the support by means of co-travelling holding threads.

7. A process according to claim 6 in which the co-travelling holding threads are arranged in the form of an endless belt.

8. A process according to any of claims 1 to 7 in which the filamentary material is a polyamide material.

9. A process according to any of claims 1 to 8 in which the filament layer is dyed in continuous operation.

10. A process according to any of claims 1

to 8 in which the filamentary layer is dyed by means of a printing technique.

11. A process according to any of claims 1 to 10 in which the filamentary material is one having a latent crimp before being subjected to the deposition and dyeing steps.

12. A process according to claim 11 comprising restoring a crimp to the material after the deposition and either before or after the dyeing step, such restoration of a crimp involving heat treatment of the material.

13. A process according to claim 12 in which the heat treatment comprises steaming of the material.

14. A process for dyeing a continuous filamentary material substantially as hereinbefore described with reference to the accompanying drawing.

15. Filamentary material whenever dyed by the process of any of claims 1 — 14.

For the Applicants,
CARPMAELS & RANSFORD,
Chartered Patent Agents,
24, Southampton Buildings,
Chancery Lane, London, W.C.2.

Leamington Spa: Printed for Her Majesty's Stationery Office by the Courier Press.—1967.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

1065109 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*